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WHAT IS CLAIMED IS:

- 1. A semiconductor device comprising:
- a semiconductor substrate, and
- a circuit element using an insulating film formed on said semiconductor substrate,

said insulating film containing a silicon compound containing at least one element selected from the group consisting of an oxygen and a nitrogen, and a metal compound containing a metal other than silicon and at least one element selected from the group consisting of an oxygen and a nitrogen, nano-crystals being formed in said insulating film, the size of said nano-crystal being small enough to permit observation of a polycrystalline ring as a diffraction image when an electron beam having a beam diameter of the nanometer order is incident in parallel to said insulating film surface.

- 2. The semiconductor device according to claim 1, wherein said a silicon compound is a compound selected from the group consisting of a silicon oxide, a silicon nitride, and a silicon oxynitride.
- 3. The semiconductor device according to claim 1, wherein said nano-crystal grains are made of said metal compound.
- 4. The semiconductor device according to claim 2, wherein said nano-crystal grains are made of an oxide, a nitride or an oxynitride of a metal other than

silicon.

- 5. The semiconductor device according to claim 1, wherein said nano-crystals grains has a diameter falling within a range of between 1 nm and 10 nm.
- 6. The semiconductor device according to claim 1, wherein said insulating film has a thickness falling within a range of between 3 nm and 20 nm.
 - 7. The semiconductor device according to claim 1, wherein an oxynitride film is formed between said semiconductor substrate and said insulating film.
 - 8. The semiconductor device according to claim 1, wherein said metals other than silicon is at least one metal selected from the group consisting of Ti, Ta, Y, Al, Zr, La, Hf, Nb and elements of lanthanum series.
 - 9. The semiconductor device according to claim 1, wherein said functional element is a MOSFET, and said insulating film is a gate insulating film of said MOSFET.
 - 10. The semiconductor device according to claim 1, wherein said nano-crystals being formed in said insulating film, the size of the largest nano-crystal grain in said insulating film being not larger than the thickness of said insulating film.
 - 11. The semiconductor device according to claim 10, wherein the size in the thickness direction of said insulating film of the largest nano-crystal grain formed in said insulating film is substantially

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equal to the thickness of said insulating film.

- 12. The semiconductor device according to claim 1, wherein a part of the periphery of at least one of said nano-crystals being positioned within a distance of 0.7 nm from the interface of said insulating film.
- 13. The semiconductor device according to claim 1, wherein said insulating film is a mixed film containing said silicon compound and said metal compound.
- 14. A method of manufacturing a semiconductor device according to claim 1, comprising:

forming an insulating film containing a silicon compound containing at least one element selected from the group consisting of an oxygen and a nitrogen, and a metal compound containing a metal other than silicon and at least one element selected from the group consisting of an oxygen and a nitrogen, on a semiconductor substrate under temperatures at which crystallization does not take place; and

applying a heat treatment to precipitate a nanocrystalline metal oxide within said mixed film.

15. A method of manufacturing a semiconductor device, comprising:

forming insulating film being a mixed film including a silicon compound containing at least one element selected from the group consisting of an oxygen and a nitrogen, and a metal compound containing a metal other than silicon and at least one element selected

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from the group consisting of an oxygen and a nitrogen on a semiconductor substrate under temperatures at which crystallization does not take place; and

applying a heat treatment to precipitate a nanocrystalline metal oxide within said mixed film.